Comparative changes in density and demography of large herbivores in the Masai Mara Reserve and its surrounding human-dominated pastoral ranches in Kenya

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Supplementary material

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Table S1. Results of Wald chi-squared tests of differences in expected herbivore densities between the Masai Mara National Reserve and the adjoining Koyiaki pastoral ranch during the dry season based on aerial surveys conducted by the Kenya Department of Resource Surveys and Remote Sensing from 1977 to 2010. All models were fitted using the negative binomial regression model except for elephant for which the Poisson model was used due to failure of the negative binomial model to converge to optimal parameter estimates.

	Thomson's gazelle			Sheep			Impala			Warthog			Grant's gazelle		
Year	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*
1979	3.283	1	**0.070**	0.000	1	0.898	3.111	1	**0.078**	1.351	1	0.245	6.392	1	**0.011**
1980	4.992	1	**0.025**	0.000	1	0.798	3.456	1	**0.228**	3.281	1	**0.070**	0.739	1	0.390
1982	6.658	1	**0.010**	0.000	1	0.956	3.761	1	**0.184**	1.261	1	0.262	3.623	1	**0.020**
1983	6.997	1	**0.008**	0.000	1	0.938	3.419	1	0.023	0.865	1	0.352	4.785	1	**0.029**
1984	3.438	1	**0.023**	0.000	1	0.975	0.964	1	0.326	3.298	1	**0.069**	3.639	1	**0.010**
1986	0.714	1	0.398	0.000	1	0.998	7.912	1	**0.005**	1.042	1	0.307	0.048	1	0.826
1990	0.027	1	0.870	0.002	1	0.964	1.872	1	0.171	1.088	1	0.297	0.204	1	0.652
1991	1.088	1	0.297	1.207	1	0.272	1.984	1	0.159	0.001	1	1.000	10.717	1	**0.001**

1992	1.287	1	0.257	2.383	1	0.123	3.559	1	**0.059**	0.001	1	0.971	1.365	1	**0.024**
1996	0.377	1	0.539	1.163	1	0.281	2.873	1	**0.090**	3.337	1	**0.068**	0.940	1	**0.033**
2009	0.001	1	0.974	7.699	1	**0.006**	1.030	1	0.310	0.001	1	0.972	0.545	1	0.460
2010	3.456	1	**0.023**	6.723	1	**0.010**	2.271	1	0.132	0.421	1	0.516	0.000	1	0.990

	Topi			Wildebeest			Hartebeest			Waterbuck			Cattle		
Year	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*
1979	0.593	1	0.441	9.132	1	**0.003**	0.314	1	0.575	0.000	1	0.991	8.904	1	**0.003**
1980	0.165	1	0.685	0.006	1	0.940	0.195	1	0.658	0.000	1	0.989	8.753	1	**0.003**
1982	3.481	1	**0.488**	0.502	1	0.479	0.000	1	0.993	0.005	1	0.945	0.001	1	0.996
1983	0.152	1	0.697	6.587	1	**0.010**	3.103	1	**0.294**	5.802	1	**0.016**	0.001	1	0.997
1984	0.972	1	0.324	0.830	1	0.362	0.092	1	0.762	0.092	1	0.761	0.074	1	0.785
1986	0.138	1	0.710	3.096	1	**0.078**	0.404	1	0.525	0.000	1	1.000	4.458	1	**0.035**
1990	3.038	1	**0.081**	0.767	1	0.381	2.145	1	**0.143**	1.231	1	0.267	5.820	1	**0.016**
1991	0.017	1	0.898	4.544	1	**0.031**	1.116	1	0.291	0.000	1	1.000	5.141	1	**0.023**
1992	3.422	1	**0.052**	10.291	1	**0.001**	2.966	1	**0.033**	0.000	1	0.970	2.017	1	0.156
1996	0.351	1	**0.062**	0.012	1	0.914	0.066	1	0.798	0.000	1	0.992	0.347	1	0.556
2009	0.118	1	0.731	6.983	1	**0.008**	0.046	1	0.831	0.000	1	0.983	1.252	1	0.263
2010	0.001	1	0.976	3.968	1	**0.016**	3.783	1	**0.376**	0.000	1	0.985	3.802	1	**0.051**

	Zebra			Eland			Buffalo			Giraffe			Elephant		
Year	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*
1979	28.468	1	**0.000**	2.264	1	0.132	3.440	1	**0.064**	0.354	1	0.552	1.057	1	0.304
1980	0.539	1	0.463	0.401	1	0.526	3.826	1	**0.050**	3.481	1	**0.049**	0.100	1	0.752
1982	6.822	1	**0.009**	0.694	1	0.405	0.276	1	0.599	0.009	1	0.924	0.007	1	0.933
1983	4.841	1	**0.028**	3.976	1	**0.032**	3.702	1	0.010	0.074	1	0.786	3.730	1	**0.053**
1984	1.205	1	0.272	0.156	1	0.693	2.545	1	0.111	3.002	1	**0.097**	0.712	1	0.399
1986	18.607	1	**0.000**	0.000	1	0.994	0.292	1	0.589	4.060	1	**0.081**	0.592	1	0.442
1990	7.106	1	**0.008**	0.000	1	0.991	3.405	1	**0.065**	0.004	1	0.948	0.095	1	0.758
1991	10.628	1	**0.001**	0.105	1	0.745	4.091	1	**0.043**	3.240	1	0.062	1.057	1	0.304
1992	13.392	1	**0.000**	0.175	1	0.675	10.302	1	**0.001**	0.087	1	0.768	0.100	1	0.752
1996	2.251	1	0.134	2.286	1	0.131	0.299	1	0.584	0.112	1	0.738	0.007	1	0.933
2009	14.186	1	**0.000**	3.190	1	**0.074**	3.491	1	**0.062**	0.296	1	0.586	0.000	1	0.989
2010	15.446	1	**0.000**	3.984	1	**0.046**	3.507	1	**0.061**	0.048	1	0.827	0.592	1	0.442

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Table S2. Results of Wald chi-squared tests of differences in expected herbivore densities between the Masai Mara National Reserve and the adjoining Koyiaki pastoral ranch during the wet season based on aerial surveys conducted by the Kenya Department of Resource Surveys and Remote Sensing from 1977 to 2010. All models were fitted using the negative binomial regression model except for elephant for which the Poisson model was used due to failure of the negative binomial model to converge optimal parameter estimates.

	Thomson's gazelle			Sheep			Impala			Warthog			Grant's gazelle		
Year	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*
1977	4.827	1	**0.028**	3.896	1	**0.048**	0.041	1	0.840	9.820	1	**0.002**	5.113	1	**0.024**
1978	6.153	1	**0.013**	10.924	1	**0.001**	5.242	1	**0.022**	6.469	1	**0.011**	11.679	1	**0.001**
1979	5.023	1	**0.025**	19.727	1	**0.000**	3.465	1	**0.063**	0.020	1	0.887	15.125	1	**0.000**
1982	9.427	1	**0.002**	4.672	1	**0.031**	1.410	1	0.235	14.867	1	**0.000**	8.829	1	**0.003**
1983	7.248	1	**0.007**	0.001	1	0.996	1.296	1	0.255	4.699	1	**0.030**	1.415	1	0.234
1984	1.278	1	0.258	1.278	1	0.258	1.240	1	0.265	1.027	1	0.311	1.896	1	0.169
1985	3.226	1	**0.072**	1.953	1	0.162	1.284	1	0.257	4.955	1	**0.026**	1.721	1	0.190
1986	5.678	1	**0.017**	0.000	1	0.986	0.875	1	0.350	3.565	1	**0.059**	10.223	1	**0.001**
1987	4.013	1	**0.016**	2.195	1	0.138	0.073	1	0.787	0.129	1	0.720	0.552	1	0.458
1989	3.558	1	**0.046**	0.000	1	1.000	0.170	1	0.680	0.715	1	0.398	0.003	1	0.958
1991	1.293	1	0.255	0.000	1	0.997	2.918	1	0.098	7.108	1	**0.008**	0.402	1	0.526
1992	0.390	1	0.532	3.453	1	**0.063**	3.064	1	**0.151**	0.263	1	0.608	3.060	1	**0.030**
1993	0.617	1	0.432	0.000	1	0.996	2.853	1	0.091	0.550	1	0.458	1.997	1	0.158
1994	0.014	1	0.904	5.813	1	**0.016**	1.328	1	0.249	0.529	1	0.467	0.009	1	0.925
1997	0.185	1	0.668	0.000	1	0.990	1.820	1	0.177	0.765	1	0.382	1.976	1	0.160
2000	0.040	1	0.841	3.498	1	**0.221**	8.683	1	**0.003**	0.000	1	0.998	0.826	1	0.363
2002	0.028	1	0.867	3.317	1	**0.251**	8.777	1	**0.003**	0.000	1	0.999	4.458	1	0.050
2005	3.090	1	0.079	6.902	1	**0.009**	7.117	1	**0.008**	6.127	1	**0.013**	0.376	1	0.540
2007	0.269	1	0.604	0.000	1	0.989	0.897	1	0.344	4.051	1	**0.044**	0.329	1	0.566
2008	1.333	1	0.248	15.110	1	**0.000**	4.528	1	**0.033**	25.323	1	**0.000**	0.368	1	0.544

	Topi			Wildebeest			Hartebeest			Waterbuck			Cattle		
Year	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*
1977	0.631	1	0.427	4.934	1	**0.026**	0.429	1	0.512	4.471	1	**0.034**	9.294	1	**0.002**
1978	0.535	1	0.465	0.622	1	0.430	0.229	1	0.632	9.526	1	**0.002**	0.737	1	0.391
1979	2.453	1	0.117	3.050	1	**0.081**	0.953	1	0.329	8.447	1	**0.004**	18.117	1	**0.000**
1982	2.966	1	**0.085**	9.444	1	**0.002**	0.993	1	0.319	1.564	1	0.211	7.970	1	**0.005**
1983	0.171	1	0.680	0.226	1	0.635	4.949	1	**0.016**	3.930	1	**0.047**	0.000	1	0.986
1984	0.175	1	0.676	14.136	1	**0.000**	0.231	1	0.631	2.707	1	**0.100**	0.000	1	0.993
1985	0.263	1	0.608	1.863	1	0.172	0.447	1	0.504	5.510	1	**0.019**	10.465	1	**0.001**

1986	0.026	1	0.871	0.017	1	0.897	6.226	1	**0.013**	5.161	1	**0.023**	74.311	1	**0.000**
1987	0.219	1	0.640	1.393	1	0.238	1.914	1	0.166	0.005	1	0.941	5.780	1	**0.016**
1989	0.062	1	0.803	0.322	1	0.570	0.170	1	0.680	0.408	1	0.523	0.002	1	0.968
1991	1.172	1	0.279	6.864	1	**0.009**	3.693	1	**0.055**	0.000	1	0.980	7.364	1	**0.007**
1992	0.083	1	0.773	3.842	1	**0.050**	0.431	1	0.511	0.000	1	0.981	1.176	1	0.278
1993	1.047	1	0.306	10.577	1	**0.001**	3.313	1	**0.058**	0.092	1	0.761	1.884	1	0.170
1994	0.113	1	0.736	3.873	1	**0.049**	0.286	1	0.593	0.000	1	0.991	3.168	1	**0.075**
1997	3.097	1	**0.029**	1.091	1	0.296	0.599	1	0.439	0.021	1	0.885	2.243	1	0.134
2000	0.211	1	0.646	2.736	1	**0.098**	0.002	1	0.968	0.000	1	0.991	0.406	1	0.524
2002	0.165	1	0.685	0.693	1	0.405	1.322	1	0.888	0.002	1	0.962	0.830	1	0.362
2005	0.864	1	0.353	2.694	1	0.999	0.517	1	0.472	0.779	1	0.378	2.655	1	0.103
2007	0.428	1	0.513	0.023	1	0.879	0.830	1	0.362	0.000	1	0.993	6.153	1	**0.013**
2008	0.520	1	0.471	0.162	1	0.687	0.185	1	0.667	0.000	1	0.992	1.243	1	0.265

	Zebra			Eland			Buffalo			Giraffe			Elephant		
Year	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*	χ^2	df	*P*
1977	3.203	1	**0.074**	0.504	1	0.478	5.476	1	**0.019**	0.006	1	0.938	0.002	1	0.963
1978	5.364	1	**0.021**	3.430	1	**0.051**	1.194	1	0.274	4.495	1	**0.034**	3.178	1	**0.075**
1979	0.356	1	0.551	0.178	1	0.673	0.520	1	0.471	3.882	1	**0.049**	3.727	1	**0.054**
1982	11.834	1	**0.001**	1.588	1	0.208	0.363	1	0.547	2.307	1	0.129	8.762	1	**0.003**
1983	5.119	1	**0.024**	3.662	1	**0.056**	0.693	1	0.405	0.706	1	0.401	5.347	1	**0.021**
1984	22.693	1	**0.000**	2.883	1	**0.090**	0.410	1	0.522	0.994	1	0.319	0.001	1	0.980
1985	0.882	1	0.348	0.585	1	0.444	6.578	1	**0.010**	1.092	1	0.296	13.217	1	**0.000**
1986	0.004	1	0.952	4.499	1	**0.034**	13.142	1	**0.000**	4.105	1	**0.043**	0.327	1	0.567
1987	3.183	1	**0.074**	0.249	1	0.618	0.185	1	0.667	3.242	1	**0.062**	0.371	1	0.543
1989	0.251	1	0.616	1.682	1	0.195	4.639	1	**0.031**	0.015	1	0.903	0.150	1	0.699
1991	0.193	1	0.661	1.814	1	0.178	4.141	1	**0.042**	0.019	1	0.891	0.609	1	0.435
1992	2.725	1	**0.099**	0.656	1	0.418	3.306	1	**0.069**	4.604	1	**0.032**	3.255	1	**0.071**
1993	9.466	1	**0.002**	0.036	1	0.849	0.414	1	0.520	3.756	1	**0.053**	0.001	1	0.980
1994	2.007	1	0.157	0.414	1	0.520	0.062	1	0.803	4.146	1	**0.042**	-0.405	1	1.000
1997	1.451	1	0.228	3.420	1	**0.064**	1.433	1	0.231	0.962	1	0.327	4.864	1	**0.035**
2000	0.249	1	0.618	3.665	1	**0.056**	3.153	1	**0.076**	0.166	1	0.684	0.191	1	0.662

2002	0.054	1	0.816	2.077	1	0.149	0.001	1	0.977	0.099	1	0.752	0.371	1	0.543
2005	1.948	1	0.163	1.682	1	0.195	1.025	1	0.311	0.035	1	0.851	0.015	1	0.902
2007	9.562	1	**0.002**	4.021	1	**0.045**	0.019	1	0.890	0.150	1	0.699	0.661	1	0.416
2008	3.078	1	**0.079**	0.144	1	0.705	0.026	1	0.871	0.558	1	0.455	1.126	1	0.289